Tolerance, Agglomeration and Enterprise Innovation Performance: A multi-level analysis of Latin American regions[1]

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1. Introduction

The research on innovations systems at the national and regional levels has contributed to an understanding of the innovation process that stresses its interactive nature and thus emphasizes its social embeddedness. At the same time, Richard Florida´s (2002) theory of the creative class has drawn the attention to the influence tolerance, openness and cultural or social diversity play not only for the economic development of cities (Boschma & Fritsch, 2009; Florida, Mellander, & Stolarick, 2008; Kemeny, 2014), but more specifically for entrepreneurship (Audretsch, Dohse, & Niebuhr, 2010; Cheng & Li, 2012; Smallbone, Kitching, & Athayde, 2010) and innovation (Niebuhr, 2010; Qian, 2013; Qinglan & Yingbiao, 2011).

Despite this growing body of literature, there is a need for further research especially linking the different levels where tolerance may impact innovation. The tolerance – innovation link may be explored at the micro-level (individual firm) as well as at the meso-macro levels (city, region, or nation). In this study, we go beyond most research by adopting a multi-level approach to the study of tolerance, which we define in terms of a population's openness to cultural and ethnic diversity. The main aim of this paper is investigate how tolerance at the regional level impacts on enterprise innovation performance across the regions of 7 Latin American nations: Chile, Colombia, Mexico, Peru, Argentina, Ecuador and Uruguay.

Though Bamberger (2008) noted contextual research has contributed to closing the micro-macro gap in management, there has been relatively little quantitative research related

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to innovation behavior adopting a multi-level approach to test the relationship between contextual variables at the national or regional level and innovative behavior or performance at the firm-level (Beugelsdijk & Van Schaik, 2005; Lederman, 2009; Lorenz 2011, 2015; Srholec, 2010, 2011). Our research contributes to closing this research gap by using multilevel regression analysis. It avoids the ecological fallacy observed in some macro studies (Robinson, 2009) of assuming that group-level attributes and relations accurately capture individual-level relations.

At the same time, we not only focus on regional tolerance as an important contextual variable influencing the innovation performance of firms. Closely linked to any discussion of regional innovation systems is the impact of the spatial concentration of economic activity on the capacity of firms to absorb knowledge and develop new product or technologies (Asheim & Gertler, 2005). It is widely recognized in the innovation studies literature that the knowledge needed for new product development is partially tacit in nature and at the same time that face-to-face interactions can facilitate the exchange of this knowledge (Lundvall and Johnson, 1994; Lawson and Lorenz, 1999; Pavitt, 2002; Chesbrough, 2003; West & Bogers, 2011). These features of knowledge imply that firms may derive non-pecuniary advantages from being located in proximity to concentrations of firms operating in the same or related sectors of activity and we assess the potential impact of such regional agglomeration effects and how they may interact with regional tolerance in affecting the innovation performance of firms.

Our paper also contributes to the growing understanding of the innovation activities of manufacturing firms in developing countries by placing it in the context of Latin America. Innovation surveys, the basis for much of empirical research in industrialized countries, are a relatively recent phenomenon in Latin America (Castellacci & Natera, 2012). Initially based on the Oslo Manual (OECD, 2005), methodological guidelines were adapted to better suit the characteristics of innovation and technology diffusion in this region, resulting in the so-called Bogotá Manual (RICYT, OEA, & CYTED, 2001). Even though most Latin American countries follow these guidelines (Sutz, 2000), the level of harmonization is low (Castellacci & Natera, 2012)[2] thus limiting cross-country studies. The lack of comparative studies gains importance in light of the highly divergent empirical results of innovation studies in this region. Crespi and Zuñiga (2012), for example, point out that drivers for innovation investment are much more heterogeneous for Latin American countries than for OECD

[2] For a comparison and a methodological discussion of the different innovation surveys, please refer to Crespi & Peirano (2007) and Anlló et al. (2014).

countries just as there are inconclusive results regarding the ability of Latin American firms to convert innovation into increased labor productivity. The current study relies on the World Bank´s Enterprise Surveys for Latin America, thus allowing for a comparative study in this region based on the use of harmonized measures of innovation. It extends knowledge derived from the few and very recent comparative studies in the region (Crespi, Tacsir, & Vargas, 2011; Crespi & Zuñiga, 2012).

We further contribute to the understanding of the innovation process in developing countries by differentiating between firms in terms of the level of novelty of their innovation activities. Latin American countries are developing countries where imitation or technology transfer are common practice (Anlló & Suárez, 2009) and lead to innovations that are typically characterized by incremental changes. Innovations involving the development of genuinely new products on the world market based on heavy R&D investments, on the contrary, are rare. By differentiating innovators according to levels of novelty, our study extends current understanding which is still limited regarding drivers of creative imitation (R. P. Lee & Zhou, 2012).

The paper is structured the following way. First, in Section 2, we review the current literature and develop our key hypotheses regarding the impact of tolerance and agglomeration on innovation performance. In Section 3 we describe the data, its sources and the multi-level methodology applied. In Section 4 we develop the econometric models and present the basic results and in Section 5 we conclude and identify useful extensions of this research.

2. Background literature

2.1. Innovation in the context of Latin America

The Latin American region has been characterized by a relatively prolonged period of economic growth with rapidly growing GDP per capita in the last decade. Yet, it still lags significantly behind industrialized countries; this situation will likely worsen with lower commodity prices. Innovation and technology adaption are key factors in boosting productivity which for these countries has been growing at lower rates than the world´s technological frontier growth rate (Pagés, 2010). A recent study for Latin American countries confirms the impact of knowledge investments on the level of productivity, reporting productivity gaps between innovative and non-innovative manufacturing firms in these countries that are more than twice as high as in industrialized countries (Crespi & Zuñiga,

2012). Thus, understanding how innovation can be fostered and nurtured in the context of Latin America is important.

It has been long argued that studies in developing countries need to evaluate the firm´s capabilities to innovate in light of national factors (Dahlman, Ross-Larson, & Westphal, 1987; Lall, 1992). Thus, it is important to understand the specificities of innovation in this context. Relatively low investments in R&D for which incentives are weak or even absent (Acemoglu, Aghion, & Zilibotti, 2006) and which not always seem to translate into a higher propensity to introduce technological innovation (e.g. Benavente, 2006) characterize Latin America. In many of these countries, firms´ innovations consist in incremental changes based on imitation or technology transfer (Anlló & Suárez, 2009). Despite the common phenomenon of product imitation, theoretical development and empirical evidence regarding drivers of this innovation strategy remain scarce (R. P. Lee & Zhou, 2012). At the same time, literature has stressed extensively the roles of imitation and technology acquisition as preconditions for learning and catching up (Bell & Pavitt, 1997). This is especially true if the innovation process moves on from 'duplicative imitation', to 'creative imitation' and finally towards innovation in the sense of developing genuinely new products and technologies on world market as is true of a number of successful Korean enterprises (Lee and Lim, 2010; Kim, 1997). Against this backdrop, our study contrasts different degree of novelty by differentiating between new-to-the-firm and new-to-the-market-product innovatiors.

2.2. Tolerance versus diversity

Despite the recognition that tolerance, social and cultural diversity and openness influence regional economic development, the terms are often used interchangeably (Qian, 2013). Florida (2003, p. 10) defines tolerance as "openness, inclusiveness, and diversity to all ethnicities, races, and walks of life". He has translated this definition primarily into three different measures of tolerance: the Gay Index, the Bohemian Index and the Melting Pot Index which have been used in empirical research and reflect the regional density of gays and lesbians, Bohemians, and immigrants respectively.

However, recent literature has drawn a distincton between tolerance and diversity (Reese & Sands, 2008). The expression of "tolerance of societal or cultural diversity" as used for example in business ethics (Valentine & Fleischman, 2002) clarifies this differentiation. Whereas diversity is reflected by the distribution of people across different societal or cultural groups, tolerance involves the comparison with one´s standard for certain beliefs or practices and implies the co-existence and integration of at least two differing groups. Qian (2013)

therefore argues that Florida´s tolerance measures proxy tolerance whereas diversity should be measured by an index of how specialized a region or nation is in terms of the distribution of different socio-cultural groups. Our analysis focuses on tolerance understood as openness to social and cultural diversity among groups at the regional level and the influence it exercises on the innovation performance of firms.

2.3. Tolerance and innovation

Since the publication of Florida´s *The Rise of the Creative Class* (Florida, 2002), tolerance and societal or cultural diversity are increasingly considered influential contextual factors driving innovation. As such, several studies have linked tolerance and/or diversity with innovation (N. Lee & Nathan, 2010; Niebuhr, 2010; Ozgen, Nijkamp, & Poot, 2011a, 2011b; Qian, 2013) emphasizing different mechanisms through which this may occur.

There are a number of reasons why tolerance may have a positive impact on innovation. Firstly, tolerance is likely to contribute to the exchange of different and complementary knowledge by facilitating knowledge spill-overs (Florida et al., 2008). Due to the partially tacit nature of knowledge used in innovation activity, it has long been recognized that these spillovers are somewhat regionally bounded (Jaffe, 1986; Lawson & Lorenz, 1999; Maskell, 1998; Storper & Scott, 1994). The capacities required for the transfer of tacit knowledge are specific to space and time (Lam, 2000), as they often rely on face-to-face interaction between the involved actors (Storper & Venables, 2004). Additionally, it is spatially sticky as the social and institutional context in which it is produced permeates knowledge and influences its meaning (Gertler, 2003). Tolerance is able to lower potential barriers for face-to-face communication, especially between diverse individuals and groups and as such drives innovation through passive or active knowledge spillovers.

Second, a higher regional tolerance may have an indirect effect on innovation as it helps to attract and retain a diverse pool of human capital. Tolerance may contribute to the creation of a regionally diverse population as it lowers entry barriers, encouraging persons who value creativity and diversity to move to the specific region (Florida, 2002). This positive effect of talent attraction has been supported in several empirical investigations (e.g. Boschma & Fritsch, 2009; Mellander & Florida, 2011).

2.4. Tolerance and the city-region context

One of the central issues addressed in the literature on the geographical determinants of innovation is the importance of agglomeration economies in general and in particular the

way the size and economic diversity of urban agglomerations can impact positively on innovative performance (Carlino et al. 2004; Ciccone 2002; Crescenzi and Storper, 2007; Sedgley and Elmslie 2004). Large and densely populated urban agglomerations benefit from Marshallian externalities associated with labor pooling and sharing, linking and matching processes between intermediate and final goods producers, and knowledge spillovers resulting in the diffusion of knowledge (Duranton and Puga, 2003).

In addition to these locational advantages associated with industrial specialization and the clustering of firms in the same sector of activity, large urban agglomerations may benefit from Jacobian externalities associated with economic diversity. Jacob (1969) argued that knowledge may spillover between different and related industries facilitating search and exploration among diverse firms and agents. As a result, agglomeration economies are likely to positively influence the generation of innovation. We argue that these potential benefits of agglomeration are more likely to be realized in regional setting where tolerance is high. Tolerance increases the chances of the forms of interactive learning that contribute to knowledge diffusion and even to the creation of new knowledge resulting in improved or novel products

2.5 Tolerance and local-global interactions

As discussed above, in a developing country context much of the innovation activity of firms takes the form of imitation of existing products and technologies with possible adaptations to meet the requirements of local markets. Innovation in the sense of developing 'world first' products or technologies is relatively rare and in most cases when firms in developing countries state that they have introduced a product which is new-to-the market the market referred to will be local or national. Access to external sources of codified knowledge will often be important for these locally or nationally oriented new-to-the market innovators but equally important will be their ability to adapt this possibly global knowledge into products that meet the requirements of local or national markets. For the introduction of new-to-the market products where the novelty requirements are relatively high, innovation can be understood as a combined process often involving R&D in order to absorb new 'global' codified knowledge, and practical problem-solving and interactive learning at the local level in order to transform this knowledge into commercially viable products for local or national markets. Certain authors refer to the absorption of new codified knowledge from outside the region as 'global pipelines' in relation to the geographically situated interactive learning processes which are labeled as 'local buzz' (Isaksen, 2003; Bathelt, Malberg and Maskell, 2004; Storper and Venables, 2003).

A related idea has been developed in the literature on clusters or regional systems of innovation in developing nations. In this context, 'gatekeepers' link the local networks or clusters of firms to external sources of knowledge and contribute to its local diffusion through their dense connections with local firms and agents (Giuliani, 2005; Bell and Albu, 1999; Giuliani and Bell, 2005: Humphrey and Schmitz, 2002). While high levels of local or regional tolerance are unlikely to contribute much to gaining access to external sources of knowledge they will be important to the 'local buzz' or learning processes involving face-to-face contact between users and producers, as well as cooperation with local organizations including training and technical institutes. For these reasons we argue that regional tolerance will contribute to the capacity of firms to develop and introduce new to the market product innovations in cases where the firm's main markets are either local or national.

3. Data and methodology

3.1. Regional tolerance – the World Value Survey

The data for constructing regional tolerance levels is derived from the results of the 5th and 6th World Values Surveys carried out in 2005-2009 and 2010-2014 respectively. We link this data to micro-level data on enterprise innovation outcomes derived from the results of World Bank Enterprise Surveys carried out in Latin America during 2010.. The World Values Surveys are carried out by a global network of social scientists studying changing values and their impact on social and political life. The survey addresses such topics as economic development, democratization, religion, gender equality, social capital, and subjective well-being. It covers a large number of nations in all regions of the world ranging from very poor to very rich countries.

Samples for the surveys are drawn from the entire population of 18 years and older with the minimum sample being 1000. In most countries, some form of stratified random sampling is used to obtain representative national samples. In the first stages, a random selection of sampling points is made based on the given society statistical regions, districts, census units, election sections, electoral registers or voting stations and central population registers. In most countries the population size and/or degree of urbanization of these PSUs are taken into account.[3]

[3] For details on the World Values Survey sampling methodology, see: http://www.worldvaluessurvey.org/WVSContents.jsp

3.2. Firm-level indicators – the World Bank Enterprise Survey

The World Bank Enterprise surveys are firm-level surveys of representative samples of key manufacturing and service sectors in each country. The survey has been carried out in 135 nations since 2000 and covers all regions of the world. A broad range of topics are addressed including access to finance, corruption, infrastructure, crime, competition, and performance measures including innovation in most waves of the survey. The sampling methodology is stratified random sampling with strata according to firm size, business sector, and geographic region within a country.[4]

3.3. Regional matching

Both the World Values Survey and the World Bank Enterprise Survey code individual respectively firms according to region. In the case of the WVS the regional break-down is according to the largest administrative jurisdiction: provinces in the cases of Argentina and Ecuador, states in the case of Mexico, departments in the case of Uruguay and Colombia and regions in the case of Peru. An exception is Chile where the data is broken down according to the divisions of north, central, south and the Santiago Metropolitan Region rather than by region, the largest administrative jurisdiction. The major urban agglomerations are treated differently from the province, states, regions or departments. In Mexico sampling includes the Federal District which is a separate federal entity encompassing Mexico City, not forming part of any of the 31 states. Figures for Buenos Aires are for Gran Buenos Aires which is not a jurisdiction and includes the Autonomous City of Buenos Aires as well as 26 adjacent municipalities. Figures for Bogotá are for Bogota Capital District and in the case of Peru figures are for Lima Province which is the only province not belonging to any of the 25 regions.

In the World Bank Enterprise surveys the within nation regional breakdown in most cases is not by administrative jurisdiction, as in the case of the WVS, but rather by major city and the surrounding business area. For example, in the case of Colombia the regional stratification of the sample was defined in four cities: Bogota, Cali, Medellin, and Barranquilla. In order to match the two surveys, we have matched the cities and their surrounding areas used to stratify the World Bank Enterprise surveys to the appropriate administrative region identified in the stratification of the World Values Survey. Table A in

[4] For details on the sampling methodology of the World Bank Enterprise survey, see http://www.enterprisesurveys.org//Methodology

the appendix gives the correspondence between the two surveys and the number of observations by region for each survey. Regions with less and 35 observations have been excluded.

3.4. Variable description

Dependent variable. Our dependent variable is a binary measure of firm innovation. The innovation measures are based on the enterprise surveys carried out by the World Bank in Latin America in 2010. The innovation measures are based on the Oslo Manual definitions with a question asking the respondent whether or not the firm has introduced onto the market a new or significantly improved product and a question asking whether or not the product is new not only to the firm but also new to the firm's market. We use both of these measures for product innovation in order to explore the determinants of different degrees of novelty in innovation outcomes. The shares of product innovators in each region, according to the two measures, are presented in Table 1.

Firm-level independent variables. The World Bank Surveys include a variety of enterprise level indicators relating to investment, sales, R&D, employment, training, and finance. For the purposes of the analysis of the impact of regional tolerance on enterprise innovation performance, we include as enterprise-level covariates and controls whether the firm undertakes R&D expenditures, whether it provide formal vocational training for it full-time employees, whether it has direct or indirect exports, whether any of the principal owners are female, and size in terms of employment. Table 2 includes a definition of each of these variables as well as descriptive statistics.

Table 1
Regional-level aggregates: 28 Latin American regions

	New to firm product innovators %[1]	New to market product	Tolerance measure[2]	Population (millions)	GDP % of national
Region	New_Firm	New_Mkt	TOL	POP	GDP_REG
Santiago RM, CL	59.5	28.5	.0040866	6.683	45.9
Antofagasta, CL	59.0	24.5	.4458106	.531	12.6
Los Lagos, CL	56.9	25.3	.4439426	.768	2.63
Valparaiso, CL	45.8	23.3	.4666184	1.698	8.6
Bogota DF, CO	67.6	49.3	1.04016	7.879	25.4
Valle de Cauca, CO	64.7	28.7	1.136084	4.56	9.9
Antioquia, CO	71.9	46.4	.9492053	6.3	13.2
Atlantico, CO	34.9	18.9	.8908404	2.403	3.8
Coahuila, MX	26.0	12.3	.6473961	2.93	5.2
Distrito Federal, MX	40.2	16.3	.9774242	8.872	17.2
Jalisco, MX	29.7	10.4	.3393127	7.554	6.3
Estado de Mexico, MX	51.8	29.2	.3649665	16.619	9.4
Nuevo Leon, MX	45.8	16.4	-4.390005	4.826	7.6
Puebla, MX	21.2	11.5	-.924903	5.914	3.4
Guanajuato, MX	51.8	22.7	-.8197877	5.486	3.9
Lima Dept, PE	62.9	35.9	.7145452	9.752	44.3
Arequipa, PE	66.3	44.5	.1423961	1.14	5.3
Lambayeque, PE	56.1	36.3	.788076	1.091	2.4
La Libertad, PE	71.6	32.8	.6684479	1.6176	4.7
Montevideo Dept, UY	60.2	29.7	.8352967	1.319	46.2
Canelones Dept, UY	77.0	10.5	.8932326	.52	10.8
Pichincha, EC	54.2	37.1	-4.048447	2.576	24.4
Guayas, EC	45.4	29.3	-3.07693	3.645	26.8
Azulay, EC	47.0	12.1	-4.00103	.712	4.9
Gran Buenos Aires, AR	72.0	33.1	1.395885	12.801	25.7
Santa Fe Province, AR	68.9	15.7	1.197433	3.195	7.2
Mendoza Province, AR	62.6	29.1	.6959574	1.739	4.2
Cordoba Province, AR	44.6	35.1	1.138508	3.309	7.3

Sources: 5th and 6th World Values Survey; World Bank Enterprise Survey; World Bank Indicators.
1. Weighted percentages.
2. Based on weighted data.

TABLE 2

Definition of enterprise-level variables and descriptive statistics

Variable name	Definition	Mean*	Std. dev	min	max
New-to-firm	Binary variable equal 1 if the firm has introduced any new or significantly improved products over the last 3 years, 0 otherwise	.56	.50	0	1
New-to-mkt	Binary variable equal to 1 if the firm has introduced a product which is not only new to the firm but also new to the firm's market, 0 otherwise.	.29	.45	1	2
female_owner	Binary variable equals 1 if any of the firm's principal owners are female, 0 otherwise	.31	.46	0	1
export	Binary variable equals 1 if the firm has direct or indirect exports, 0 otherwise	.34	.47	0	1
train	Binary variable equals 1 if the firm offers formal (beyond "on the job") training to its permanent employees, 0 otherwise	.50	.50	0	1
r&d	Binary variable equals 1 if the firm spent R&D over the last year, 0 otherwise	.43	.50	0	1
size cat. 1	Binary variable equals 1 if the firm employs between 1 and 49 employees, 0 otherwise	.47	.50	0	1
size cat. 2	Binary variable equals 1 if the firm employs between 50 and 249 employees, 0 otherwise	.36	.48	0	1
size cat. 3	Binary variable equals 1 if the firm employs between 250 and 499employee, 0 otherwise	.17	.38	0	1
mkt cat. 1	Binary variable equals 1 if the firm's main market is local or municipal 0 otherwise	.44	.50	0	1
mkt cat.2	Binary variable equals 1if the firm's main market is national, 0 otherwise	.49	.50	0	1
mkt cat.3	Binary variable equals 1 if the firm's main market is international, 0 otherwise	.07	.25	0	1

Source: World Bank Enterprise surveys.
* Means are equal to the percentage frequency for binary variable.

Independent regional-level variable. We draw on the results of the 5th and 6th World Value Surveys to build our tolerance measure from a series of questions asking respondents to mention whether they would not like to have specific groups of people as neighbors. We use the three questions referring to people of a different race, to people of a different religion and to immigrants or foreigners. The percentage of respondents in each region not mentioning

these categories or groups were calculated to capture facets of tolerance and a principal components analysis was undertaken on the three variables for the 28 regions. The regional factor scores on the first factor, which accounts for over 93 percent of the total variance in the data set, is our measure of regional tolerance. Descriptive statistics for the three original tolerance variables used in the principal components analysis is given in Table 3 and the values of the factor scores on the first factor for each region are reported in Table 1.

TABLE 3

Descriptive statistics for tolerance variables

	mean	S.E.	Racial	Religious	Foreigners
Racial tolerance	.92	9.8	1.00		
Religious tolerance	.91	10.3	.86	1.00	
Tolerance for foreigners	.90	8.8	.95	.89	1.00

Source: Authors' calculation based on the data from the World Value Survey.

Independent regional-level control variable. We develop two measures of agglomeration economies for the administrative regions identified in the WVS. One, an absolute measure, is the size of the population. The other, a relative measure, is the share of regional GDP in national GDP. Population figures are based on the most recent census figures with projections for 2010 to 2014 in the case of where census figures are prior to 2009. We use size of the regional population rather than population density due to lack of harmonization in the definition of regions across nations. This lack of harmonization has an especially large impact on the density figures for the major urban conurbations which are often administratively separate entities from the regional jurisdictions and have widely varying density figure depending on how they are defined for purposes of stratifying the sample. For example, the density figure for Gran Buenos Aires is 3,342 per km^2 while the density figure for the Autonomous City of Buenos Aires is 14,000 per km^2.

In the case of the GDP figures we use the regional share rather than the absolute value of GDP given that the large differences in the level of economic development across the nations would bias downward the figures for the poorer nations. The regional values for our measures of agglomeration economies are given in Table 1 and descriptive statistics and their correlations with our tolerance measure are given in Table 4.

TABLE 4

Descriptive statistics of regional-level variables

	mean	S.E.	TOL	POP	GDP_REG
TOL	-.039	1.69	1.00		
POP	4.52	3.97	.16	1.00	
GDP-REG	.14	.13	.01	.30	1.00

Source: Author´s calculation based on the data from the World Value Survey and Official Statistical Databases for each country

4. Econometric models and results

4.1. Multilevel modelling

In order to investigate the relationship between regional tolerance and enterprise innovation performance we make use of multi-level probit regression analysis in order to estimate the fixed effects of regional indicators on micro-level measures of enterprise innovation performance for 28 regions in 7 Latin American nations. Multi-level modelling uses hierarchically structured data, with individuals at one level being clustered within groups at a higher level. In the context of this study, firms at level-1 are clustered within regions at level-2.[5]

Given the binary nature of our dependent variable, we use multi-level probit regression analysis predicting the probability that an enterprise will innovate according to the different measures as a function of both enterprise-level variables and regional-level contextual variables. The base model takes the following form:

$$\text{New-to-firm} \sim \text{Binomial}\ (n_i, \pi_i) \qquad (1)$$

Where π_i denotes the probaility that New-to-firm equals 1.

The structure of the basic random intercept model estimated in the paper is given in equation (2). The subscripts j vary across the sample of regions and the subscrits i vary from enterprise to enterprise within regions.

$$\text{probit}\ (\pi_i) = \beta_{0j} + \beta_{1j}\text{rain}_{ij} + \beta_2\text{r\&d}_{ij} + \beta_3\text{export}_{ij} + \beta_4\text{female-owner3}_{ij} + \beta_5\text{size2}_{ij} + \beta_6\text{size3}_{ij}$$

[5] See Goldstein (2003) for a presentation of multi-level regression analysis

(2)

with

$\beta_{0j} = \beta_0 + u_{0j}$

Regional-level context variables capturing levels of tolerance and agglomeration economies are estimated by adding to the basic equation the aggregate variables TOL and POP or GDP_REG:[6]

$B_7 TOL_j + \beta_8 POP_j$ (3)

Interaction effects between tolerance and agglomeration are estimated by including variables constructed by multiplying TOL by POP or by GDP_REG:

$+ \beta_9 (TOL_j * POP_j)_j$ (4)

Since the aggregate contextual variables are continuous, the interpretation of the coefficients on the interaction terms is straight forward. Treating POP as the moderator, a positive and significant coefficient on the interaction terms means that the size of the positive impact of increasing the level of tolerance on the predicted probability of a firm introducing a new product increases for larger regional populations.

4.2. Results

Table 5 presents the results of the probit regressions in form of coefficients investigating the predictors of the probability that a firm has introduced a product which is new-to-the firm. This is a broad measure of innovation capturing both processes of adoption and diffusion as well as innovations with higher novelty requirement based on higher levels of in-house creative effort. The first column (model 1) presents the baseline level-1 regression. The positive and significant coefficients shows that higher expenditures on R&D and offering training to one's permanent employees increases the probability that the firm introduces a new-to-the firm product onto its market. The coefficient on having direct or indirect exports is only weakly positive and statistically insignificant. This result goes against the idea that trade openness has a positive impact on innovation performance. The literature often suggests that exporters will be more innovative through their contacts with more knowledgeable foreign

[6] The absence of the subscripts *i* on the coefficients for the level-2 context variables indicates that their value varies across nations but not across individuals within nations.

customers or due to the increased pressure of international competition (Almeida and Fernandes, 2008; Seker, 2009). A possible explanation for this insignificant result is the low novelty requirements of many new-to-the-firm innovations involving the adoption of product or technologies already present on local or national markets. Access to foreign knowledge is unlikely to contribute much to such purely 'duplicative imitation' activity. The results in Model 1 also show that firms with female ownership are more likely to innovate than those without and that size only exercises a weak and statistically insignificant effect on the probability of innovating. When including regional-level explanatory and control variables, the above mentioned impact of the individual-level variables does not change.

TABLE 5
Multi-level probit model of innovation with random intercepts and regional fixed effects

Dependent variable	**New-to-the firm Product**					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Fixed: Level 1						
Constant	-.44***	-.44***	-.48***	-.52***	-.42***	-.52***
training	.35***	.37***	.37***	.37***	.37***	.37***
r&d	.87***	.86**	.86**	.86**	.86**	.86**
export	.05	.03	.03	.03	.03	.03
Female_owner	.13*	.13*	.13*	.13*	.13*	.13*
Size (empl.)						
5-24	Reference					
25-100	.07	.05	.05	.05	.05	.05
> 100	-.05	-.03	-.04	-.04	-.04	-.04
Fixed: Level 2						
TOL		.05**	.04*	.04*	-.04	.05
POP			.01		-.01	
GDP_REG				.44**		.47**
TOL * POP					.02**	
TOL * GDP_REG						-.09
Random						
Intercept	.02	.02	.02	.01	.01	.01
No. Groups	*28*	*28*	*28*	*28*	*28*	*28*
N	*4454*	*4454*	*4454*	*4454*	*4454*	*4454*

* $p < .10$; ** $p < .05$; *** $p < .01$

Model 2 introduces the regional-level contextual variable measuring tolerance. The coefficient is positive and statistically significant. Models 3 and 4 add our absolute and relative measures of agglomeration economies, the size of the regional population and the share of regional in national GDP. The results show a positive and statistically significant impact of the relative agglomeration measure on innovation performance. Models 5 and 6 introduce interaction terms between tolerance and the two different measures of agglomeration economies. The results in Model 5 show a positive and statistically significant interactive effect between tolerance and the size of the regional population while in the case of the interaction with regional GDP share the coefficient is negative and statistically insignificant. The results presented in Table 5 provide clear support for hypothesis that regional tolerance impacts positively on the firm's innovation performance. The results provide some support for the idea that the positive effects of regional tolerance on innovation performance will be greater in larger agglomerations.

Table 6 presents a similar exercise for the case of firms introducing products which are not only new to the firm but also new to their market. Unlike the case of product innovation in general, the results (Model 7) show that new-to-the market innovators do not benefit from being located in relatively high tolerance regions. There is evidence that these firms benefit in their innovation performance from being located in larger agglomerations (Models 9 and 11), however the coefficients on the interaction terms between tolerance and agglomeration economies are insignificant.

A possible explanation for this difference between product innovators in general and new-to-the market innovators is that new-to-the market innovators are more highly integrated into the global economy and adopt strategies designed to access to external knowledge. The positive and significant coefficient on the export variable is consistent with this hypothesis. As the literature on technological catch-up has argued, advanced firms in developing nations may pursue global strategies to access new knowledge needed for cutting edge innovations, including partnership with more advanced multinational firms or even establishing research outposts in more developed nations (Lee and Lim, 2001). High levels of local tolerance are unlikely to contribute much to the success of such global strategies.

This explanation needs to be qualified however, by observing that in a developing country context the main markets of most firms introducing new-to-the market innovations will be either local or national and from a global perspective their innovative activity can be described as a form of imitation or diffusion that uses knowledge and technologies already available externally. As we argued above, while such locally or nationally oriented firms may

benefit in their innovation activity from having access to external knowledge, their ability to adapt this global knowledge to meet the demands of local users will often depend on locally embedded interactive learning processes involving a dense network of connections with local firms and institutions. For this reason, new-to the market innovators oriented primarily to the local or national market may well benefit from high levels of regional tolerance.

Table 6
Multi-level probit model of innovation with random intercepts and regional fixed effects

Dependent variable	**New-to-the market Innovation**					
	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Fixed: Level 1						
Constant	-1.85***	-1.20***	-1.27***	-1.25***	-1.30***	-1.35
training	.32***	.33***	.33***	.33***	.33***	.33***
r&d	78***	.76***	.76***	.76***	.76***	.76***
export	.19***	.18***	.18***	.18***	.17**	.17**
Female_owner	.04	.05	.05	.05	.05	.04
Size (empl.)						
5-24	reference					
25-100	-.07	-.07	-.07	-.07	-.07	-.08
> 100	-.08	-.03	-.07	-.07	-.07	-.07
Fixed: Level 2						
TOL		.03	.02	-.02	.02	.03
POP			.01*	.01		
GDP_REG					.53**	.61***
TOL * POP				.01		
TOl * GDP_REG						-.13
Random						
Intercept	.04	.04	..03	.03	.01	.01
No. Groups	*28*	*28*	*28*	*28*	*28*	*28*
N	*4454*	*4454*	*4454*	*4454*	*4454*	*4454*

In order to provide evidence relevant to these arguments, in Table 7 we present the results of multilevel probit regressions that include a variable differentiating firms according to whether their main market is local, national or international. We investigate how these differences in the firm's main market interact with the level of regional tolerance. Our expectation is that relative to firms whose main market is international, firms whose main market is local or national will benefit positively in their new-to-the market innovation activity from being located in relatively high tolerance regions.

The baseline Model 13 without regional fixed effects shows, somewhat surprisingly, that firms whose main market is local or national are more likely to develop a new-to-the market product innovations than firms with an international main market. The effect is stronger and more highly significant in the case of firms whose main market is national. Two factors may be at work here. Firstly, this difference may reflect the higher novelty requirements of successfully introducing a product which is new on international markets. and Few firms in the Latin American context have the technological creative in-house capabilities needed for competing internationally at the forefront of world technology. A second factor is that in a developing country context many of the firms producing primarily for the international market will be integrated into global value chains whose governance is dominated by multinationals from more advanced nations. These firms may upgrade their products periodically according to the specifications dictated by overseas multinationals but their innovative activity although new-to-the firm will not be new on the international market.

Table 7

Multi-level probit model of innovation with random intercepts, random coefficients and regional fixed effects

Dependent	**New-to-the market innovation**		
	Model 13	Model 14	Model 15
Fixed: Level 1			
Constant	-1.74***	-1.40***	-1.34***
training	.32***	.32***	.32***
r&d	.76***	.75***	.75***
export	.23	.20***	.20***
Female_owner	.03	.094	.038
Size (emp.)			
5-24		reference	
25-100	-.07	-.08	-.08
> 100	-.07	-.08	-.07
Main market			
Local	.19*	.09	.08
National	.30***	.21***	.21**
International		reference	
Fixed: Level 2			
TOL		-.12**	-.03
POP		.01*	.00
TOL * Local		.18***	
TOL * National		.15***	
TOL*POP			-.01
TOL * POP * Local			.02*
TOL * POP * Nat			.02*
Random			
Intercept	.03	.01	.03
Coefficient: Local		.01	.02
Coefficient: Nat.		.00	.00
No. Groups	*28*	*28*	*28*
N	*4434*	*4434*	*4434*

* $p < .10$; ** $p < .05$; *** $p < .01$

The results in Model 14 show positive and statistically significant coefficients on the terms measuring interaction effects between the level of regional tolerance and having one's main market local or national. These results support our hypothesis that regional tolerance will have a positive impact on enterprise innovation performance in cases where the firm's main market is local or national. The results in Model 15 extend the analysis by including three-way interaction terms between the level of tolerance, the absolute measure of agglomeration economies, and having one's main market local or national. In both the cases of having the local or national market as the firm´s main market, the coefficients are positive and statistically significant at the .1 level. We therefore provide first empirical evidence that firms with a local or national market orientation benefit in their new-to-the market innovation activities by being located in large and tolerant agglomerations.

5. Conclusions

In this paper we have made a first attempt to explore the relation of tolerance to the innovation performance of firms in different Latin American regions. Our analysis has shown that differences in the level of tolerance matter for innovation performance. Moreover, by exploring the way tolerance interacts with agglomeration size, our results show that being located in a high tolerance region increases the chances that firms will benefit in their innovation activities from the agglomeration economies that characterise large urban conglomerations. At the same time our results provide insight into the specificities of firm innovation activity in the Latin American context. Although slightly under a third of the firms in our sample report having introduced a new-to-market product innovation, the large majority of these firms (over 90 percent) produce mainly for the local or national market. This hints at the dominance of processes of diffusion and creative imitation of products and technologies developed first by external firms and organisations in the new-to-the market innovation activity of Latin American enterprises. Our results show that these innovators who can play a key role by linking the regional and national economies to external sources of knowledge benefit from being located in large and highly tolerant regional agglomerations.

Our analysis can usefully be extended in a number of respects. Agglomeration economies are captured with measures of the absolute and relative size of agglomerations, and it would be informative to explore how size interacts with different levels of industrial specialisation and diversity and in this way make a distinction between the importance of Marshallian and Jacobian externalities. It would also be useful to extend the analysis to

regions in other parts of the world and to explore what may be specific to Latin America. While there is considerable inter-regional variation in levels of tolerance within Latin American nations, the Latin American region as a whole appears to be characterised by relatively high levels of tolerance when compared to nations in other parts of the globe.[7] A broader international project would allow us to determine how general our findings are and whether broad differences in the social and political context that are common to groups of nations in different parts of the world impact on regional innovation dynamics.

[7] Based on the results of the 5th WVS, less than 6 percent of respondents in the 7 Latin American nations covered in this study indicated that they would not like to have persons of another race as neighbours, while the percentage for the entire sample of nations in the survey covering the different regions of the world is over 17 percent.

Annex

Table A1

Correspondence between Regions in the World Values Survey And the World Bank Enterprise Survey

World Values Survey regions	No. Obs.	World Bank Survey regions	No Obs.
Zona Metropolitana, CL	501	Santiago RM, CL	524
North, CL	148	Antofagasta, CL	48
Central, CL	123	Valparaiso, CL	72
South, CL	228	Los Lagos, CL	103
Bogota DF, CO	264	Bogota, CO	402
Valle de Cauca, CO	144	Cali, CO	75
Antioquia, CO	168	Medellin, CO	133
Atlantico, CO	96	Barranquilla, CO	263
Coahuila, MX	36	Monclova, MX	53
Distrito Federal, MX	156	Distrito Federal, MX	247
Jalisco, MX	108	Guadalajara, MX	218
Estado de Mexico, MX	156	AMCM, MX	206
Nuevo Leon, MX	60	Monterry, MX	173
Puebla, MX	72	Puebla, MX	84
Guanajuato, MX	72	Leon, MX	132
Lima Dept, PE	440	Lima, PE	592
Arequipa, PE	90	Arequipa, PE	75
Lambayeque, PE	95	Chiclayo, PE	35
La Libertad, PE	110	Trujillo, PE	46
Montevideo Dept, UY	452	Montevideo, UY	311
Canelones Dept, UY	151	Canelones, UY	39
Pichincha, EC	228	Pichincha, EC	41
Guayas, EC	370	Guayas, EC	44
Azulay, EC	59	Azuay, EC	35
Gran Buenos Aires, AR	415	Buenos Aires, AR	503
Santa Fe Province, AR	120	Rosario, AR	103
Mendoza Province, AR	60	Mendoza, AR	78
Cordoba Province, AR	60	Cordoba, AR	82

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